INDOOR AIR QUALITY ASSESSMENT

Massachusetts Commission for the Blind
800 Purchase Street
New Bedford, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program

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Background/Introduction

At the request of Roger Tremblay, Human Resources Director, Office of Disabilities & Community Services, Executive Office of Health and Human Resources (EOHHS), the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH) provided assistance and consultation regarding indoor air quality concerns at the Massachusetts Commission for the Blind (MCB) located at 800 Purchase Street, New Bedford Massachusetts.

On October 2, 2007, a visit to conduct an assessment was made to this building by Cory Holmes, an Environmental Analyst in BEH's Indoor Air Quality (IAQ) Program. The assessment was prompted by symptoms (e.g., headaches, eye/respiratory irritation, stuffiness) that occupants believe may be associated with indoor air quality. At the time of assessment, the MCB areas were undergoing renovations related to a flooding event.

The MCB is located on the second floor of the five-story Cherry and Webb Building in downtown New Bedford. The MCB space consists of a central work area divided into personal work stations and perimeter offices. Building materials in the MCB are comprised of gypsum wallboard, fibrous ceiling tiles and a Gyp-Crete™ floor, which is a lightweight, semi-porous, gypsum/concrete material that was covered by carpet squares. The University of Massachusetts (UMass) also occupies portions of the first and second floors. The BEH assessment was limited to areas occupied by the MCB and UMass.

It was reported by MCB staff and Mr. Robert Sudduth, Building Owner and Property Manager, that flooding had occurred between 1:00 and 2:00 am on the morning of September 22, 2007. The building owner was contacted shortly after this event by the New Bedford Fire Department. Mr. Sudduth reportedly contacted Serv-Pro, a flood restoration firm who arrived on-scene to commence drying operations at approximately 6:00 am. It was determined that the flooding had occurred due to a ruptured hose from a heat pump located above the ceiling tile system in the main area of the MCB. As a result, porous building materials [e.g., ceiling tiles, gypsum wallboard (GW), flooring and carpeting] were water damaged. As previously mentioned, remediation efforts were underway at the time of the assessment. Details regarding remediation are discussed in the *Microbial/Moisture Concerns* section of this assessment.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with a TSI, Q-Trak, IAQ Monitor Model 8551. BEH staff performed a visual inspection of building materials for water damage and/or microbial growth. Moisture content of porous building materials was measured with Delmhorst, BD-2000 Model, Moisture Detector with a Delmhorst Standard Probe.

Results

The MCB is a field office, with a total staff of 14. Due to the nature of their work (i.e. visiting clients on-site), staff reportedly spend the majority of their time away from the office. At the time of the assessment, the office was occupied by approximately 10 individuals including staff and visitors. Test results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were below 800 parts per million (ppm), indicating adequate air exchange in all the areas surveyed during the assessment.

Mechanical ventilation is provided by rooftop air-handling units (AHUs). Fresh air is drawn into the AHUs and delivered to occupied areas via ceiling-mounted air diffusers (Pictures 1 and 2). Return air is drawn into a ceiling return plenum via ceiling-mounted grates (Picture 3) and ducted back to the AHUs. Airflow is facilitated and conditioned by a number of heat pumps located above ceiling tiles (Picture 4).

Digital thermostats control each heating, ventilating and air conditioning (HVAC) system. Thermostats have fan settings of “on” and “automatic”. Thermostats were set to the “on” setting in the areas surveyed during the assessment providing continuous airflow to aid drying.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. It is recommended that HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The MDPH uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please see Appendix A.

Temperature readings ranged from 70^{o} F to 72^{o} F, which were within the MDPH recommended comfort guidelines in all areas surveyed during the assessment. The MDPH recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. Chronic temperature control complaints were expressed by occupants of the MCB, particularly along perimeter areas. In some cases, occupants had sealed slotted air diffusers, in an attempt to improve comfort (Picture 2). This alteration of the system can cause the system to become unbalanced and create uneven heating/cooling conditions in adjacent areas. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity measured in the building ranged from 47 to 59 percent, which was within the MDPH recommended comfort range the day of the assessment. It is important to note that during the assessment several industrial dehumidifiers were in use for drying operations (Picture 5). The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. While temperature is mainly a comfort issue, relative humidity in excess of 70 percent for extended periods of time can provide an environment for mold and fungal growth (ASHRAE, 1989). Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

In order for building materials to support mold growth, a source of water exposure is necessary (e.g., roof/plumbing leaks). Identification and elimination of water moistening building materials is necessary to control mold growth. Materials with increased moisture content *over normal* concentrations may indicate the possible presence of mold growth. BEH staff conducted moisture testing of GW and carpeting in a number of areas likely impacted by water damage. Carpet squares throughout the common work area of the MCB were found to have elevated (i.e., saturated) moisture content levels at the time of the assessment (Table 1).

It is important to note that moisture content of materials is a real-time measurement of the conditions present in the building at the time of the assessment. Repeated water damage to porous building materials (e.g., GW, ceiling tiles, and carpeting) can result in microbial growth. The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If not dried within this time frame, mold growth may occur. Once mold has colonized porous materials, they are difficult to clean and should be removed. Visible mold growth was observed behind vinyl base coving in UMass room 109 (Picture 6).

At the time of the assessment, water damaged ceiling tiles, GW and carpet squares in a number of areas had been removed to aid in drying the ceiling plenum, wall cavities and floor, respectively (Pictures 7 to 9). Drying was being achieved through the use of industrial floor fans and dehumidifiers, but was limited by the presence of office furnishings, other office materials and staff in the main area of the MCB (Picture 10).

The main area of the MCB where the water damage occurred should be considered a remediation site. At the time of the assessment, Mr. Holmes recommended that opportunities for exposure be reduced/eliminated by temporarily relocating staff located in the main area of the MCB off-site or to perimeter offices within the building that were not affected by the water damage. Mr. Holmes emphasized the importance of preventive measures (e.g., isolation, pressurization, dust control) when conducting remediation to reduce/eliminate any possible migration of materials (e.g., mold spores, construction dust, fiberglass; Pictures 11 and 12) into non-remediation areas.

A few other potential mold sources were identified at the MCB. Several areas had water damaged ceiling tiles, which can indicate leaks from the roof or plumbing system (Picture 13). Water damaged ceiling tiles can provide a source of mold and should be replaced after a water leak is discovered and repaired. Breaches were observed between the counter and sink backsplash in the MCB break room (Picture 14). If not watertight, water can penetrate through these seams. Water penetration and chronic exposure of porous and wood-based materials can cause these materials to swell and show signs of water damage, which can subsequently lead to mold growth.

Conclusions/Recommendations

The conditions noted at the MCB raise a number of indoor air quality issues. The symptoms reported (e.g. headaches, eye/respiratory irritation, stuffiness) are consistent with those expected based on conditions observed during the assessment. The presence of exposed fiberglass insulation, open ceiling plenum and dust and debris from the removal of GW can all be sources of eye/respiratory irritation. In addition, the operation of drying fans and industrial dehumidifiers creates air movement that can re-aerosolize such irritants. Finally, in order to conduct a thorough drying of moistened building materials, it is necessary to remove staff and items from the remediation area.

In view of the findings at the time of the assessment, the following recommendations are made:

1. Relocate staff from the central MCB in order to prevent exposure to remediation pollutants and facilitate drying.
2. Continue to remove and replace all water damaged/mold colonized porous building materials (i.e., GW in room UMass 109, ceiling tiles and carpet squares in the MCB). This measure will remove actively growing mold colonies that may be present. This work should be conducted at a time when occupants are not present in the area. Once work is completed, ensure that the area is thoroughly cleaned and disinfected with an appropriate antimicrobial. Dust and particulates resulting from renovation efforts in carpeted areas should be vacuumed with a HEPA filtered vacuum cleaner.

3. Mold remediation should be conducted in a manner consistent with recommendations in "Mold Remediation in Schools and Commercial Buildings" published by the US Environmental Protection Agency (US EPA, 2001). This document can be downloaded from the US EPA website at: http://www.epa.gov/iaq/molds/mold_remediation.html.
4. Ensure that the general mechanical ventilation system is deactivated and/or sealed (i.e., supply and return vents) in areas of remediation when conducted activities that generate excessive dust, odors or fumes. However, when these activities are *not* being conducted, the mechanical ventilation system should be utilized to facilitate drying activities.
5. If possible, relocate sensitive individuals [i.e. those with pre-existing medical conditions (e.g., hypersensitivity, respiratory disease/asthma)] to locations furthest away from areas of remediation.
6. Implement prudent housekeeping and work site practices to minimize exposure to renovation pollutants. To control for dusts, a HEPA equipped vacuum cleaner in conjunction with wet wiping/mopping of all surfaces is recommended.
7. Use local exhaust ventilation and isolation techniques to control remediation pollutants. Precautions should be taken to avoid the re-entrainment of these materials into occupied areas of the building.
8. Establish communications between all parties involved with remediation efforts, including staff and other building occupants, to prevent potential IAQ problems and to address related concerns.
9. Develop a notification system for building occupants to report remediation-related odors and/or issues to the building administrator. Have these concerns relayed to the contractor and/or contact person in a manner that allows for a timely remediation of any problems.

10. Ensure leaks are repaired and replace water-damaged ceiling tiles. Examine the area above and around these areas for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.

11. Seal areas around sink in MCB break room to prevent water-damage to the interior of cabinets and adjacent wallboard.

12. Ensure MCB staff work in conjunction with building management and their HVAC vendor to examine the configuration of floor space and the placement of supply diffusers as a means to improve thermal comfort/temperature control it is recommended.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

ASHRAE. 1989. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-1989

BOCA. 1993. The BOCA National Mechanical Code/1993. 8th ed. Building Officials and Code Administrators International, Inc., Country Club Hill, IL. Section M-308.1.1.

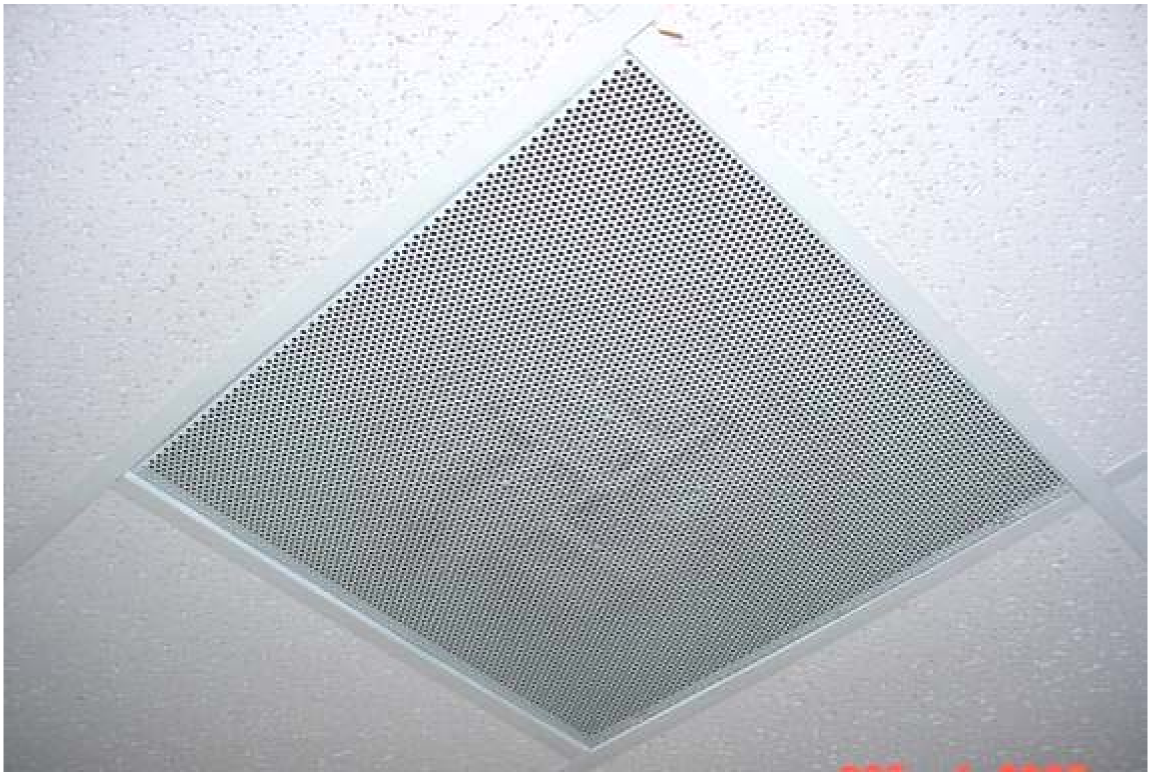
OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

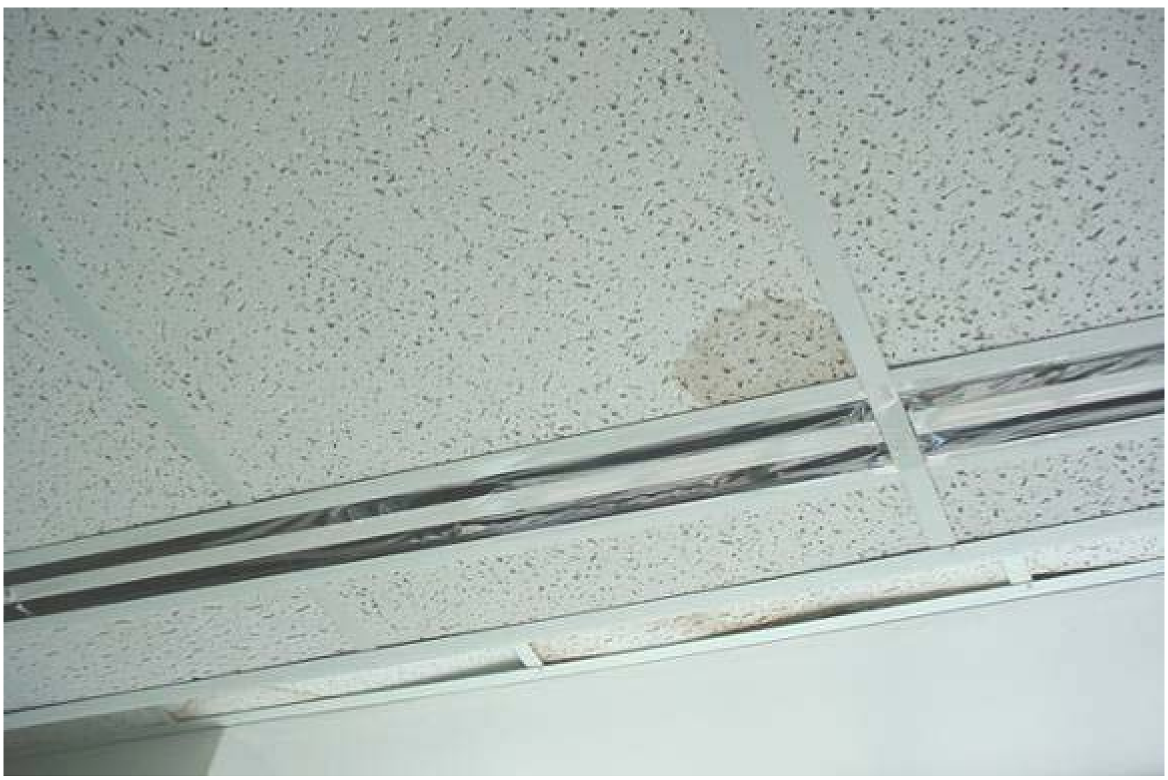
US EPA. 2001. Mold Remediation in Schools and Commercial Buildings. US Environmental Protection Agency, Office of Air and Radiation, Indoor Environments Division, Washington, D.C. EPA 402-K-01-001. March 2001.

Picture 1



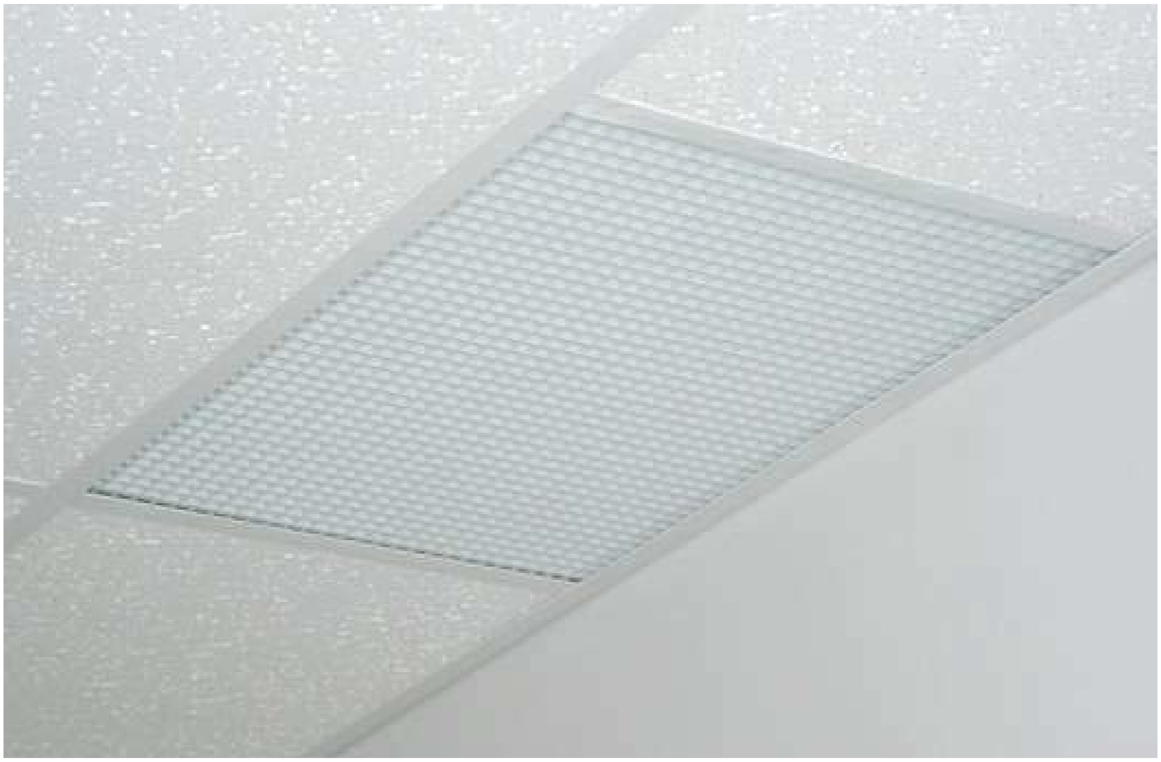
Ceiling-Mounted Supply Diffuser

Picture 2



Slotted Supply Diffuser along Perimeter of MCB, Note Vents are Sealed with Clear Plastic Tape

Picture 3



Ceiling-Mounted Exhaust Grate

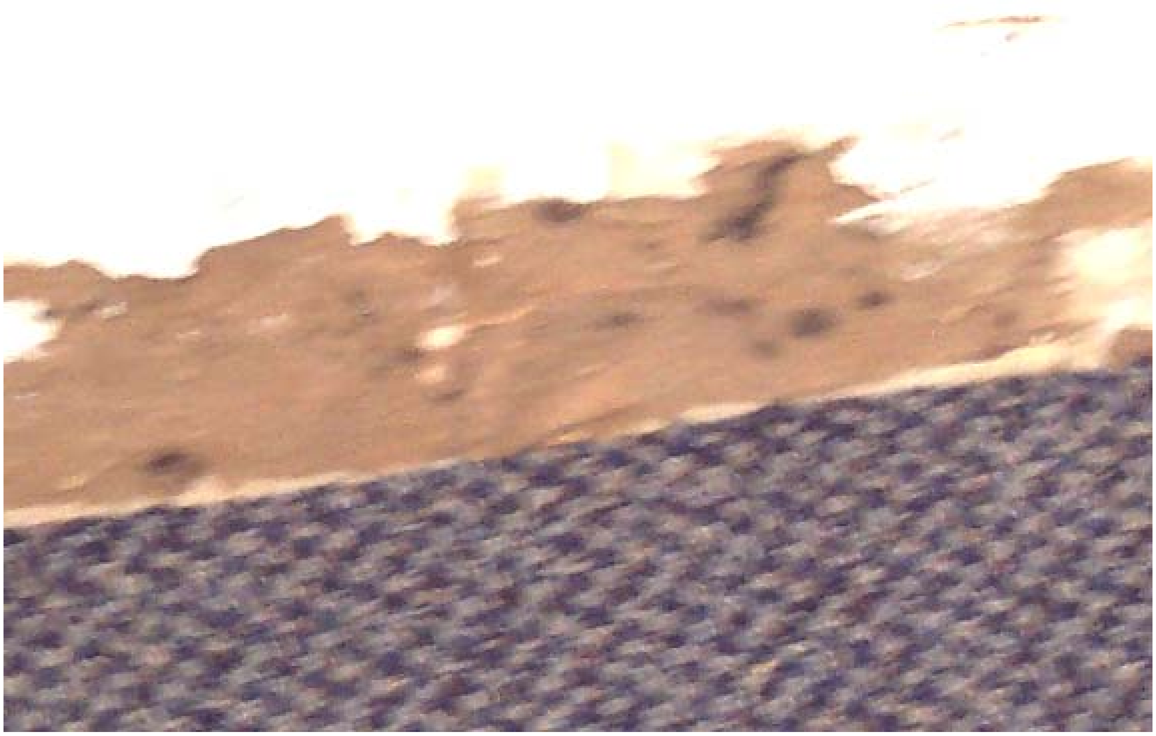
Picture 4

Heat Pump Located in Central MCB above Ceiling Tile System, Note Hose, Which was the Origen of the Flooding Incident

Picture 5

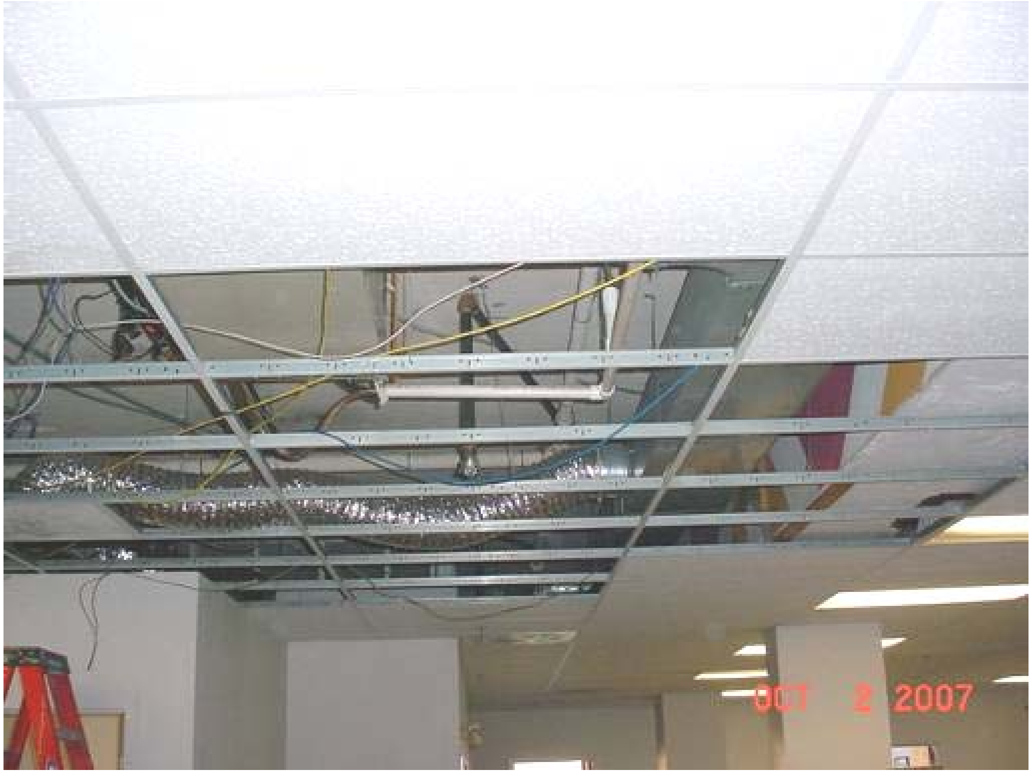
One of Several Industrial-Sized Dehumidifiers in use at the MCB

Picture 6



Visible Mold Growth (as Indicated by Dark Spots) behind Vinyl Base Coving in UMass room 109

Picture 7



Ceiling Tiles Removed to Dry Ceiling Plenum

Picture 8

Portions of GW and Carpet Squares Removed

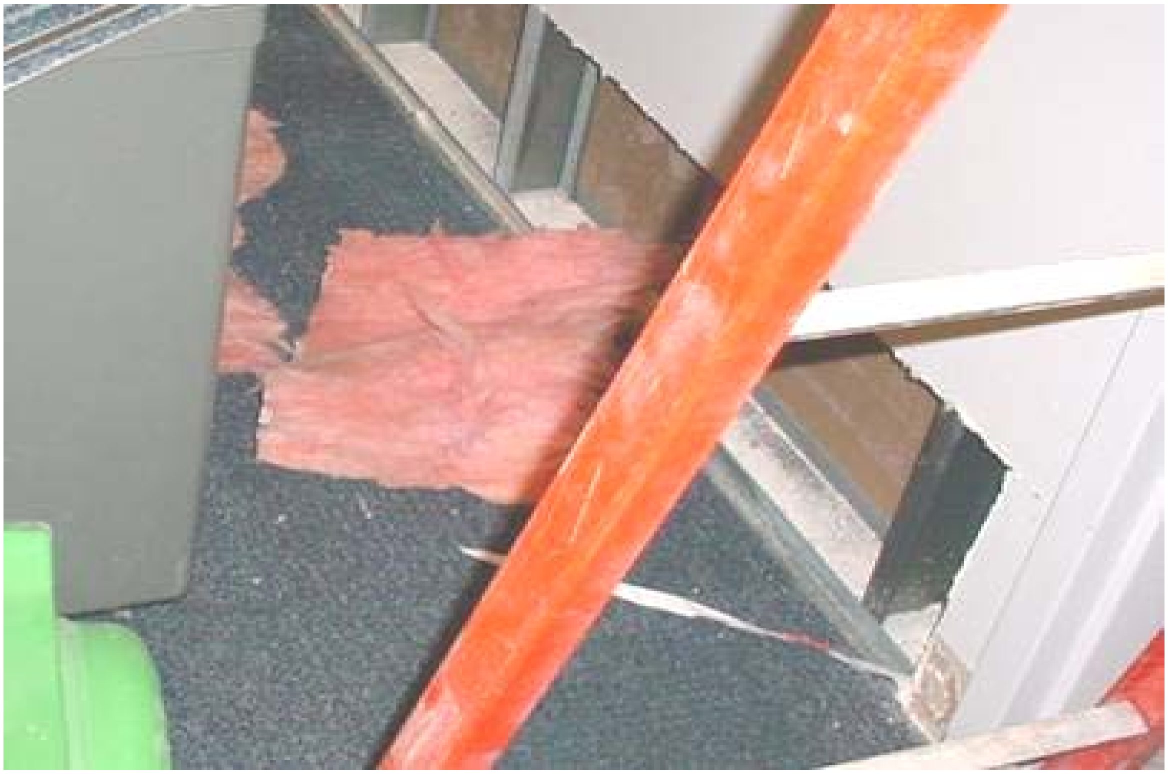
Picture 9

Portions of GW and Carpet Squared Removes, Note Exposed Fiberglass Insulation

Picture 10

Office Furnishings and Other Items in Main Area of the MCB

Picture 11



Fiberglass Insulation and GW Dust and Debris

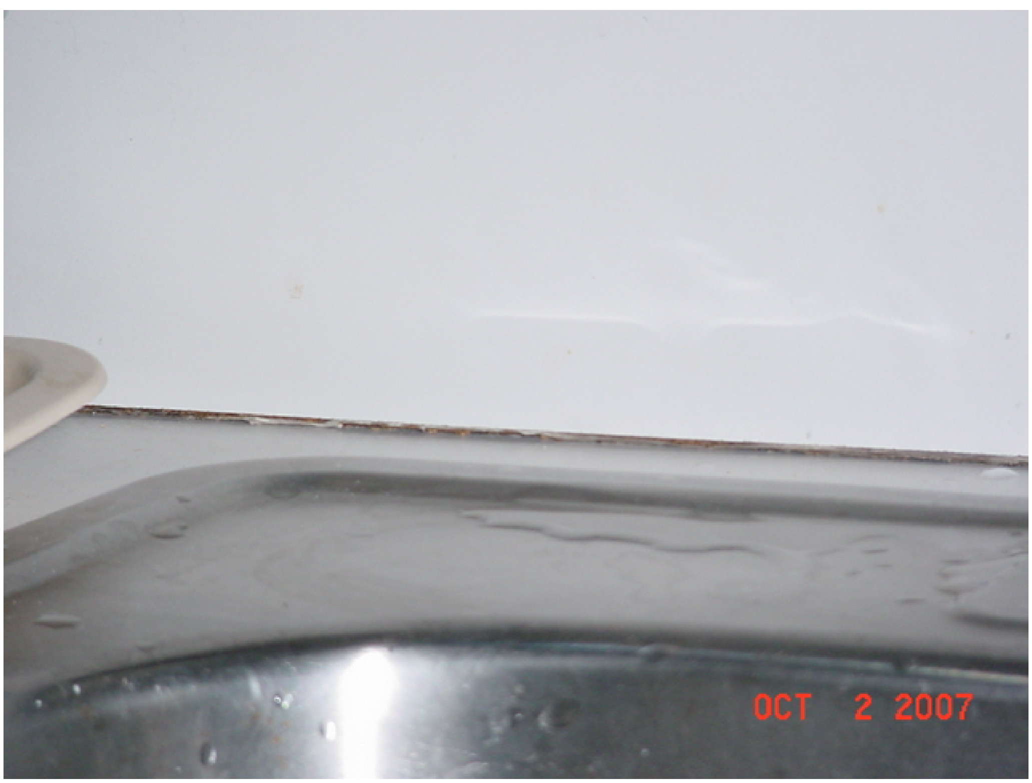
Picture 12

GW Dust and Debris

Picture 13

Water Damaged Ceiling Tiles in Director's Office

Picture 14



Breach between Sink Backsplash and Countertop in MCB Break Room

Location: MA Commission for the Blind | **Indoor Air Results**

Address: 800 Purchase St, New Bedford, MA | **Date: October 2, 2007**

Table 1

Location	Carbon Dioxide (*ppm)	Temp (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks/Moisture Testing
						Supply	Exhaust	
Background	389	72	79					
LL15	732	71	47	0	N	N	N	
231	728	70	47	0	N	Y	Y	
233	727	70	47	0	Y	Y	Y	
234	736	`70	48	1	Y	Y	Y	
Leland Office	769	70	49	3	Y	Y	Y	3 water damaged ceiling tiles
Kenny	756	71	48	3	N	Y	Y	Carpet-elevated moisture
Delmonte	756	71	48	1	N	Y	Y	Carpet-elevated moisture
Break Room	756	72	50	0	N	Y	Y	Breach sink countertop/backsplash
Moniz	728	71	48	1	N	Y	Y	
IT Area	701	71	47	0	N	Y	Y	
Geary	710	72	49	1	N	Y	Y	Carpet-elevated moisture

ppm = parts per million

Comfort Guidelines

Carbon Dioxide:	< 600 ppm = preferred	Temperature:	70 - 78 °F
	600 - 800 ppm = acceptable	Relative Humidity:	40 - 60%
	> 800 ppm = indicative of ventilation problems		

Location: MA Commission for the Blind

Address: 800 Purchase St, New Bedford, MA

Indoor Air Results

Date: October 2, 2007

Table 1 (Continued)

Location	Carbon Dioxide (*ppm)	Temp (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks/Moisture Testing
						Supply	Exhaust	
UMass Room 107	600	71	59	0	N	Y	Y	Musty odors GW-low moisture-visible mold growth behind vinyl base coving Carpet-low moisture
UMass Room 109	620	71	59	0	N	Y	Y	Musty odors GW-low moisture Carpet-low moisture

ppm = parts per million

Comfort Guidelines

Carbon Dioxide:	< 600 ppm = preferred	Temperature:	70 - 78 °F
	600 - 800 ppm = acceptable	Relative Humidity:	40 - 60%
	> 800 ppm = indicative of ventilation problems		